SECTION 9

SUMMARY OF PROPOSED PERMIT LIMITS

This section presents the current permit limits, historical performance data, technology-based permit limits, and water quality-based effluent limits developed earlier in this report. The most representative and valid permit limits are selected and presented as proposed permit limits. These limits are then checked to verify compliance with Indiana Water Quality Standards (IWQS) and to ensure an adequate margin of safety for each limit. Following these checks, final proposed permit limits are presented.

EXISTING PERMIT LIMITS VERSUS TECHNOLOGY-BASED LIMITS

The existing permit limits, historical performance data, and the BPT/BAT/BCT permit limits derived in Section 5.0 are summarized in Tables 9-1 and 9-2. Monthly average values are presented in Table 9-1 and daily maximum values in Table 9-2. The data in these tables indicate:

1) Technology-based permit limits are applicable to the Outfall 001 effluent;
2) Historical performance is better than calculated BPT/BAT/BCT permit limits; and,
3) Existing permit limits are more stringent than calculated BPT/BAT/BCT permit limits.

PROPOSED PERMIT LIMITS

The existing permit limits are also presented with calculated WQBELs in Tables 9-3 and 9-4. Monthly average values are presented in Table 9-3 and daily maximum values in Table 9-4. The footnotes for these tables explain the basis for selection of the most representative and valid permit limits.

VERIFICATION OF NON-WQBEL VALUES

Four parameters in Tables 9-3 and 9-4 have permit load limits where: i) the limits were determined by a method other than the WQBEL process, and ii) IWQS numeric criteria exist for these parameters. The parameters are total chromium, hexavalent chromium, ammonia as N, and phenolics. For these parameters the proposed permit limits were derived based upon current permit limits and the WQBEL process was not a factor.

In order to verify that IWQS criteria are achieved, the WQBEL process, described in Section 7.0, was performed for these parameters. The results of this process are presented in Table 9-5. Only the WQBEL values for phenolics exceeded the proposed permit limits, therefore, the phenolics limit in Tables 9-3 and 9-4 were replaced by those in Table 9-5.

MARGINS OF SAFETY

For the revised set of proposed permit limits, it is possible to calculate a margin of safety for these limits over a limit calculated by any of the other methods for developing limits. For parameters with numeric limits, margins of safety are presented in Tables 9-6 and 9-7 for monthly average and daily maximum conditions, respectively. Margins of safety for monthly average limits range from 21 to 74 percent, and for daily maximum limits, the range is 21 to 68 percent. The minimum margin of safety for a WQBEL is 42 percent for the monthly average ammonia as N load limit.

FINAL PROPOSED PERMIT LIMITS

For each parameter presented in this section, the most representative and valid limit is proposed as a permit limit in Table 9-8. A chronic bioassay monitoring requirement is

TABLE 8-1. SUMMARY OF TOTAL TO DISSOLVED METAL RATIOS FOR THE OUTFALL 001 EFFLUENT (a)

METAL	AVERAGE TOTAL TO DISSOLVED RATIO
Aluminum	2.4
Arsenic	1.1
Barium	1.0
Boron	1.0
Copper	4.0 (b)
Iron	6.5
Lead	6.5
Magnesium	0.9
Molybdenum	1.1
Manganese	1.0
Selenium	1.2
Zinc	4.9

Notes:
(a) From footnote C to Form 2C of the Permit Application.
(b) The majority of total copper analyses were less than the analytical detection limit, therefore, those results were not included in the average total to dissolved ratio presented here.

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focuses on the correlation among the soluble and total recoverable metals in determining the bioavailability of the metals.

During the course of effluent characterization sampling in spring 1994, Amoco studied the bioavailability of metals in the Outfall 001 effluent. Analytical data were collected on the fraction of dissolved, or soluble, metals present in the WWTP effluent. For each sampling event, total and dissolved metals analyses were performed and a total to dissolved metals ratio calculated. Using this data, and in accordance with USEPA and IDEM procedures, a representative average total to dissolved metal ratio was calculated for each metal as shown in Table 8-1. A summary report of the total versus dissolved ratio study is included in Volume I as Footnote C to Form 2C, Section V. An effluent limitation derived from a numeric metal criterion, which is expressed as total recoverable in a permit, can be adjusted based on this ratio (327 IAC 5-2-11.1 (d)).

Based upon the results of the projected effluent quality determination in Section 6.0, there is no reasonable potential for any metal to exceed a receiving water criterion. Thus, the translation of a wasteload allocation for a metal into a permit limit, allowing for bioavailability, is not needed. Nonetheless, the information presented herein is important because it demonstrates that most of the metal constituents in Amoco's effluent are not bioavailable.

SECTION 8

METALS RATIO EFFECT

While Amoco believes that no WQBELs are needed for metals, this discussion is provided as background information.

The Water Quality Criteria for metals presented in Table 1 of 327 IAC 2-1-6 are expressed in terms of the acid-soluble fraction to reflect the form of the metals used to derive the published USEPA ambient water quality criteria. Aquatic metals criteria were derived from laboratory toxicity (bioassay) tests using the acid-soluble or bioavailable form of the metals, e.g. water-soluble metal salts.

A reliable acid-soluble analytical method has not been developed by USEPA. In the absence of an analytical method to determine the acid-soluble fraction of a metal, the IWQS criteria in 327 IAC 2-1-6 Table 1 are enforced as total recoverable metals in NPDES permits. Total recoverable analyses, however, do not reflect the acid-soluble or bioavailable form of a metal.

To establish effluent limitations based on Table 1 metals criteria, 327 IAC 5-2-11.1(d)(2) allows the use of the ratio of the soluble fraction of the metal to the total recoverable fraction of the metal in the effluent. This ratio is used to adjust numeric water quality-based effluent limitations to the permit-required total recoverable limit.

IDEM draft guidance presents a procedure to determine the ratio of the soluble fraction to total recoverable fraction of the metal in discharge (*"General Guidance to Supplement 327 IAC 2-1-8.8: Variances from a State Water Quality Standard,"* February 11, 1993, OWM, IDEM"). In drafting the procedure, IDEM cites the May 1992 *"Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals,"* (OST, USEPA) which

TABLE 7–3. MIXING ZONE WASTELOAD ALLOCATION (a)

PARAMETER	CONC. UNITS	MIXING ZONE WASTELOAD ALLOCATION					POSSIBLE PERMIT LIMITS			
		4–DAY CCC STANDARD	BACKGROUND CONC.	CHRONIC WLA	CHRONIC DAILY MAXIMUM	CHRONIC MONTHLY AVERAGE	CONCENTRATION		LOAD (lb/day)	
							DAILY MAXIMUM	MONTHLY AVERAGE	DAILY MAXIMUM	MONTHLY AVERAGE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
CHLORIDES	mg/L	21.30	11	814.4	1,334.8	574.97	1,335	575	250,476	107,892
PHOSPHORUS	ug/L	42.50	30	1,005.0	1,647.2	709.5	1,647	710	309	133
SULFATES	mg/L	36.80	25	945.4	1,549.5	667.5	1,550	667	290,766	125,247
TDS	mg/L	243.60	170	5,910.8	9,687.8	4,173.0	9,688	4,173	1,817,916	783,068
AMMONIA (c)	mg/L	0.23	0.01	17.2	28.1	12.1	28.1	12.1	5,281	2,275

NOTES:
(a) ZDIM Dispersion = 54 :1
TMZ Dispersion = 77 :1
(b) WLA Flow = 22.5 MGD (IDEM WLA, September 1992)
(c) The summer 4–day CCC standard is presented since summer is the limiting season.

Column (1): Parameters where projected effluent quality indicate that a WQBEL is needed.
Column (2): Units for each parameter.
Column (3): 4–day CCC standards for 6j parameters = Lake Michigan monthly average * 1.416 (as per IDEM WLA). For ammonia, 4–day CCC standard is equivalent to the Lake Michigan monthly average (as per IDEM OWM–1).
Column (4): Background concentration are 1992 IDEM WLA values except for phosphorous which is based on USEPA STORET data (1985 to 1992) for the Whiting Intake.
Column (5): Chronic WLA = CCC * (TMZ Dispersion + 1) – BG * (TMZ Dispersion)
Column (6): Chronic daily maximum = chronic WLA * 1.639
Column (7): Chronic monthly average = chronic WLA * 0.706
Columns (8) and (9): Concentration permit limits are equal to the chronic daily and monthly average values since there are no applicable acute values.
Columns (10) and (11): Load permit limits = concentration * WLA flow * 8.34

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TABLE 7-2. WHITING INTAKE CHLORIDE MONITORING DATA SUMMARY (1966-1992)(a)

YEAR	COUNT	AVERAGE (mg/L)	C.V. (c)
1966	26	10.1	0.42
1967		No Data	No Data
1968		No Data	No Data
1969		No Data	No Data
1970	22	9.2	0.18
1971	3	11.7	0.13
1972		No Data	No Data
1973	13	11.5	0.15
1974	12	11.5	0.19
1975	12	12.6	0.57
1976	11	10.7	0.15
1977	11	11.5	0.13
1978	11	14.5	0.11
1979	11	10.7	0.30
1980	11	10.3	0.17
1981	11	11.2	0.24
1982	11	11.6	0.14
1983	10	12.1	0.15
1984	12	11.0	0.25
1985	12	11.2 (b)	0.18
1986	12	11.1	0.08
1987	11	11.3	0.18
1988	13	11.8	0.13
1989	12	12.0	0.28
1990	11	11.5	0.13
1991	11	12.0	0.13
1992	8	12.8	0.14

NOTES:

(a) References
1966 - 1968 East Chicago and Hammond data was obtained from the document Pollution of the Interstate Waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries. Progress evaluation meeting held at Chicago, Illinois on March 15, 1967. Volume 1." and the document Pollution of the Interstate Waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their Tributaries, Illinois-Indiana. Proceedings of Conference, Session (2nd) Held at Chicago, Illinois, on December 11-12, 1968. Volume 1." Both documents by the Federal Water Pollution Control Administration - Washington, D.C. - 1967 and December 12, 1968 respectively.
The remaining data was obtained from the United States Geological Survey (USGS) and US EPA STORET Database.

(b) A data point which was much higher than this value appeared in the data for this year. This data point was obviously off by a factor of 10 (e.g., a decimal point data entry error) and has been corrected.

(c) C.V. = Coefficient of Variation = (standard deviation/average).

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TABLE 7-1. LISTING OF APPLICABLE NUMERIC CRITERIA

PARAMETER	UNITS	AAC (a,b) (Maximum)	CCC (4-Day Average) (a,b)			LAKE MICHIGAN STANDARDS (c)			AVERAGE BACKGROUND CONCENTRATION (d)
			Outside of Mixing Zone		Point of Water Intake	Monthly Average	4-day CCC (e)	Daily Maximum	
			Aquatic Life (CAC)	Human Health	Human Health				
Chlorides	mg/L	860	230			15	21.3	20	11 (k)
Sulfates	mg/L		250 (f)			26	36.8	50	25.0 (k)
Total Phosphorous	mg/L					0.03	0.043	0.04	0.03 (l)
Total Dissolved Solids (g)	mg/L		750 (f)			172	243.6	200	170.0 (k)
Ammonia as N (summer) (h,i,j)	mg/L					0.23	0.23	0.46	0.01 (k)

NOTES:
(a) 327 IAC 2-1-6 Table 1, unless otherwise noted.
(b) AAC - Acute Aquatic Criterion
CCC - Continuous Criterion Concentration
CAC - Chronic Aquatic Criterion
(c) 327 IAC 2-1-6(j).
(d) Assimilative capacity is determined by comparing the 4-day CCC concentration to average background concentration. If the average background concentration is less than the 4-day CCC then assimilative capcity is available.
(e) 4-day CCC standard for Lake Michigan standards = Lake Michigan monthly avergae * 1.416 (as per IDEM WLA).
(f) Limit included in notes following 327 IAC 2-1-6 Table 1.
(g) Filtrable or dissolved solids.
(h) Monthly average unoinized ammonia standard is converted to total ammonia as N at given pH and temperature conditions. Daily maximum concentration equals twice the monthly average concentrations as per IDEM OWM-1.
(i) At pH 8.2 and 22.9°C for July through September. See note (f).
(j) Summer standard shown since summer is the most limiting season.
(k) Source is the "Wasteload Allocation of Grand Calumet River - Indiana Harbor Ship Canal", IDEM, September 1992.
(l) USEPA STORET database 1985-92.

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appropriate to use this data to establish compliance limits since historical performance data should be used.

The Form 2C data for non-DMR parameters should be used in the projection of effluent quality and determining the need for a WQBEL. The projected effluent quality procedure in Section 6 can be used to estimate maximum effluent concentrations for comparison to acute and chronic receiving water impact limits, but the procedure would be misapplied if used to establish permit compliance limits. The PEQ procedure is not designed to establish compliance limits. The factors used in the PEQ calculations cannot fully compensate for limited data on effluent variability.

WHOLE EFFLUENT TOXICITY

The projected effluent quality process in Section 6.0 indicated that a WQBEL for chronic toxicity was not needed. However, a WQBEL is proposed based upon Section 3.3.3 of the USEPA March 1991 TSD:

> *"EPA recommends that a discharger conduct chronic toxicity testing if the dilution of the effluent falls below 100:1 at the edge of the mixing zone."*

This WQBEL will be a chronic bioassay test for monitoring purposes only.

MIXING ZONES IN THE WQBEL PROCESS

The discussion of projected effluent quality in Section 6 noted that the mixing zone dispersion ratios in the WQBEL process are obtained from a universal mixing zone based upon the site-specific hydrodynamics of the new Outfall 001 discharge. One set of ZDIM and TMZ dispersion ratios are therefore used to develop the limits in Table 7-3. These limits were calculated independent of effluent characterization data. Rather the limits were based on the IWQS which, by definition, are protective of the designated use of the receiving water. For some parameters, applying the WQBEL process can result in limits higher than existing effluent levels because the WQBEL process and effluent characterization data are not related.

As required by the NPDES Permit Application Form 2C, the characterization data for the Outfall 001 effluent is representative of normal refinery production, normal wastewater treatment, and representative and valid sampling conditions. However this data, in particular for parameters not reported in the monthly Discharge Monitoring Reports (DMRs), is not sufficient to adequately characterize the variability of the effluent quality. It is therefore not

EXAMPLE OF WQBEL DEVELOPMENT

To establish WQBELs for chlorides the Lake Michigan 6(j) monthly average limit of 15 mg/L was converted to a 4-day CCC using Equation 7-2:

4-day CCC = 15 mg/L x 1.416
= 21.3 mg/L

The background chlorides concentration in Lake Michigan, as reported in the IDEM September 1992 WLA, is 11 mg/L. Using a TMZ dispersion of 77:1, the chronic WLA concentration values were calculated using Equation 7-3:

Chronic WLA = (21.3 x 78) - (11 x 77)
= 814.4 mg/L

Monthly average and daily maximum permit limits were then calculated using Equations 7-5 and 7-6:

Chronic Daily Maximum = 814.4 x 1.639
= 1,334.8 mg/L

Chronic Monthly Average = 814.4 x 0.706
= 574.97 mg/L

The monthly average and daily maximum LTA concentrations are the WQBELs for quality or concentration. WQBELs for quantity or load are calculated as follows:

Daily Maximum Load = 1,334.8 mg/L x 22.5 mgd x 8.34
= 250,476 lbs/d

Monthly Average Load = 574.97 mg/L x 22.5 mgd x 8.34
= 107,892 lbs/d

Chronic WLA = (4 Day CCC x 78) - (Background x 77) Eq. 7-3

Acute WLA = (AAC x 55) - (Background x 54) Eq. 7-4

Acute and chronic daily maximum and monthly average concentrations were determined from procedures given in the IDEM OWM-1, i.e., the factors converting wasteload allocation concentrations to daily maximum and monthly average long-term average (LTA) concentrations. The procedures in the IDEM OWM-1 are very similar to those in the USEPA March 1991 TSD. The equations used to calculate these concentrations were as follows:

Chronic Daily Maximum = Chronic WLA x 1.639 Eq. 7-5

Chronic Monthly Average = Chronic WLA x 0.706 Eq. 7-6

Acute Daily Maximum = Acute WLA Eq. 7-7

Acute Monthly Average = Acute WLA x 0.430 Eq. 7-8

Typically the lower (or limiting) acute or chronic monthly average and daily maximum concentration values are used to calculate permit limits. However, in the case of the parameters in Table 7-3, there are no acute permit limit concentration values, therefore only chronic permit limit concentrations apply.

To conclude the WQBEL process, the WLA flow of 22.5 mgd was applied to the concentration permit limits to derive mass or load limits as follows:

Daily Maximum Load (lb/day) = Daily Maximum Concentration (mg/L) x 22.5 mgd x 8.34 Eq. 7.9

Monthly Average Load (lb/day) = Monthly Average Concentration (mg/L) x 22.5 mgd x 8.34 Eq. 7.10

This flow is the maximum monthly average flow for Outfall 001 over the past three years. It is also the flow used in the IDEM Wasteload Allocation, September 1992.

4) The mixing zone dispersion used in the calculation of WLA concentration values are obtained from the "Mixing Zone Demonstration" report included with the permit application.

5) Background concentrations used in the process are taken from the IDEM September 1992 WLA or data contained in the USEPA STORET data base.

DEVELOPMENT OF WQBELs

The translation of water quality criteria in Table 7-1 to WQBELs using the wasteload allocation process is shown in Table 7-3. Even though acute WLA concentration values and corresponding acute permit limits are not applicable to the parameters in Table 7-1, the equations are provided here for completeness.

To begin the process, the monthly average limits for Lake Michigan 6(j) parameters were converted to 4-day CCC values per the IDEM September 1992 WLA using the following equation:

$$\text{4 Day CCC} = \text{Lake Michigan Monthly Average Concentration} \times 1.416 \qquad \text{Eq.7-2}$$

Chronic and acute wasteload allocation concentrations were then calculated using the April 1993 draft "Water Quality Guidance of the Great Lakes System Implementation Procedure Appendix F" mass balance methodologies for mixing zone dispersion. Based upon the results of a mixing zone demonstration using multiport diffuser modeling, as provided in Volume II of the permit application, a Total Mixing Zone dispersion (TMZ) of 77:1 was applied to the chronic wasteload allocation and a zone of discharged induced mixing (ZDIM) 54:1 was applied to acute wasteload allocations. For both chronic and acute applications, background WLA concentrations were incorporated. The equations used were as follows:

PROCEDURE FOR ESTABLISHING WQBELS

A summary of the procedure for establishing WQBELs is as follows:

Step 1 — Calculate acute and chronic wasteload allocation (WLA) concentration values:

Step 2 — Calculate the monthly average and maximum daily limits based on acute WLA concentration values;

Step 3 — Calculate the monthly average and maximum daily limits based on chronic WLA concentration values; and

Step 4 — Set the lower set of permit limits based on comparing the results of Step 2 and Step 3.

These steps are a combination of the procedures in IDEM's proposed *"Technical Release OWM-1 Procedure for Developing Water Quality-based NPDES Permit Limitations for Toxic Pollutants,"* (IDEM OWM-1) and the USEPA *"Technical Support Document for Water Quality-based Toxics Control,"* March 1991, (USEPA March 1991 TSD).

To apply this procedure to the Outfall 001 effluent, one must incorporate the following points:

1) Based on the regulatory history and scientific basis of the Lake Michigan 6(j)standards, as discussed in Section 6.2, it is appropriate to apply these limits outside the Total Mixing Zone. Both the daily maximum and monthly average 6(j) standards are to be met at the edge of the Total Mixing Zone.

2) The monthly average limits for the Lake Michigan 6(j) parameters must be converted to 4-day continuous chronic criteria (CCC) values. This is in accordance with the IDEM *"Wasteload Allocation of Grand Calumet River - Indiana Harbor Ship Canal"* (IDEM WLA), September 1992.

3) Since there are no limiting acute receiving water criteria (AAC values) for the 6(j) parameters, acute WLA concentration values cannot be calculated, thus the chronic WLA concentration values, derived from the CCC values in Step 2, are used to derive monthly average and daily maximum permit limits.

For lakes, the mass balance flow values are replaced by the volumetric dispersion derived from computer modeling or direct field measurement. For example, a 75:1 dispersion ratio means 1 part (volume) effluent is mixed with 75 parts (volumes) receiving water. For Eq 7-1:

$$Q_{PS} = 1$$

and,

$$Q_{BG} = 75 = DR \text{ (dispersion ratio)}$$

therefore,

$$C_{WQS} \times (1 + DR) = (C_{PS} \times 1) + (C_{BG} \times DR)$$

The site-specific point source WLA representing the maximum effluent concentration that can be discharged without exceeding the C_{WQS} is:

$$WLA = C_{PS} = C_{WQS} \times (1 + DR) - (C_{BG} \times DR).$$

For Amoco Outfall 001, the mass balance variables are based on the following:

C_{WQS}: Lake Michigan Water Quality Standards (see Table 7-1)

C_{BG}: IDEM WLA background Lake Michigan concentrations (see Table 7-1)

DR: Dispersion ratio projected from CORMIX2 (as described in Volume II)

In summary, the dispersion projections from the mixing zone demonstration are incorporated into the point source wasteload allocation to assure attainment of receiving water quality standards and designated uses. The WLA concentrations are subsequently utilized for WQBEL calculation procedures as detailed later in this section.

shows that additional assimilative capacity exists in the southern end of Lake Michigan since: i) concentrations levels are less than IWQS criteria, and ii) the designated use of Lake Michigan, as defined by IWQS criteria, is being attained (see Table 7-1). As a further example of long-term monitoring demonstrating available assimilative capacity, chloride monitoring data, presented as an annual average at the Whiting Intake from 1966 to 1992, is provided in Table 7-2. This data shows that Lake Michigan has been meeting its designated use as defined by the chloride IWQS criteria.

The specific source loadings that comprise a system's assimilative capacity are calculated from wasteload allocation procedures. A wasteload allocation (as per IDEM OWM-1) is the maximum effluent concentration of a constituent in a point source discharge which the receiving water can contain (assimilate) without endangering the achievement of water quality standards. A wasteload allocation is essentially an accounting procedure whereby source loads to a system are added together to examine the cumulative effect within the receiving water. This mass balance approach can be described mathematically for a single point source:

$$C_{WQS} \times (Q_{PS} + Q_{BG}) = (C_{PS} \times Q_{PS}) + (C_{BG} \times Q_{BG}) \qquad \text{Eq. 7-1}$$

Where,

C_{WQS} = Receiving water quality standard (concentration)

Q_{PS} = Point source effluent flow

Q_{BG} = Background receiving water flow

C_{PS} = Point source effluent concentration

C_{BG} = Background receiving water concentration

SECTION 7

WATER QUALITY-BASED EFFLUENT LIMITS

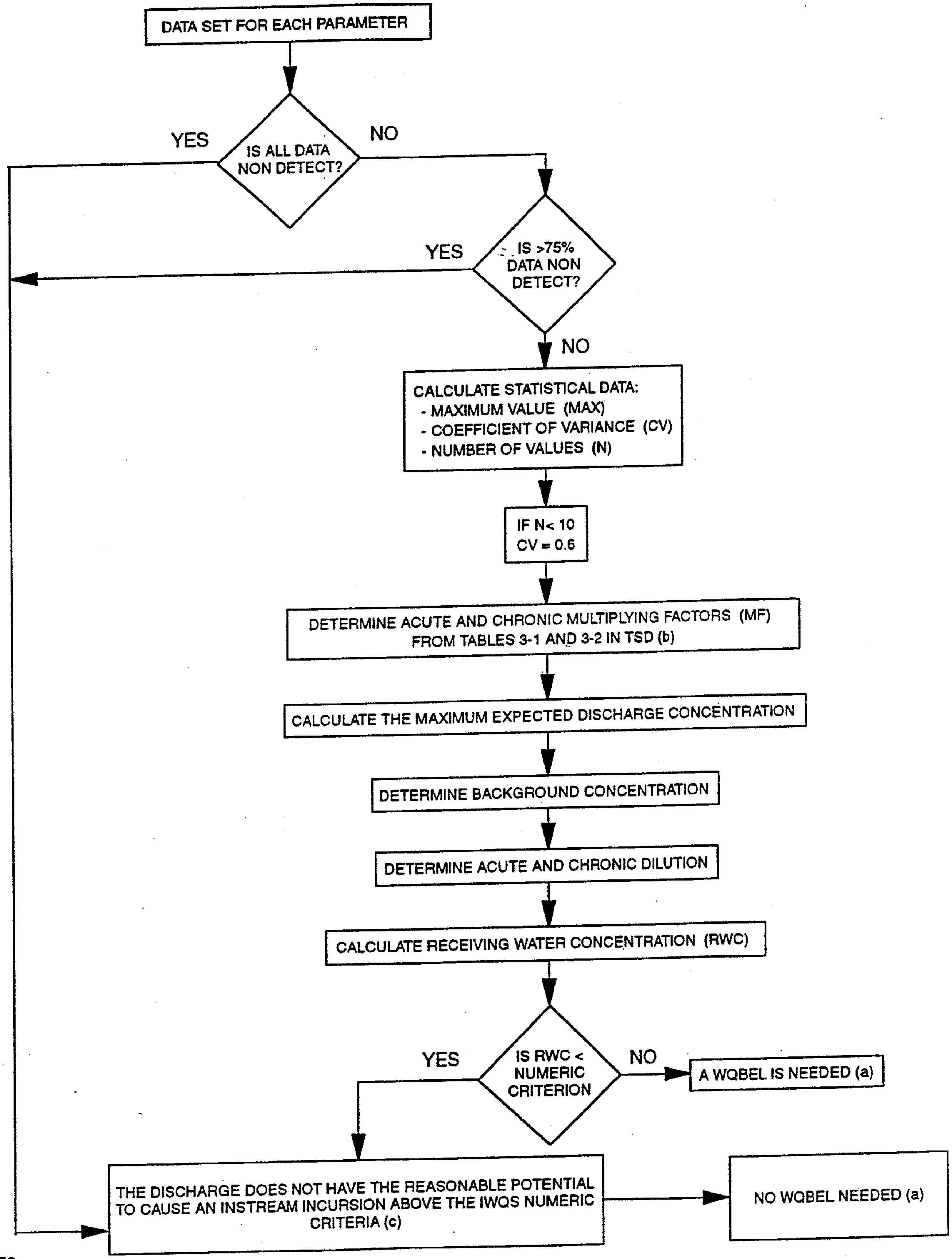
In 327 IAC 2-1-6, IDEM has established water quality standards, including numerical criteria,for waterbodies of the state [327 IAC 2-1-6(a), Table 1], plus additional water quality standards specific to the Indiana Waters of Lake Michigan [327 IAC 2-1-6(j) and 2-1-6(b)(5)(C)(ii)]. Based on the results of the implementation of the projected effluent quality procedure in Section 6.3, the applicable numerical criteria for the Whiting Refinery Outfall 001 discharge are listed in Table 7-1. This listing includes the parameters for which the projected effluent quality exceeded the numeric criteria. For the five parameters listed in Table 7-1, it is the Lake Michigan "6(j)" Standards that control the possible permit limits since they are either the only numeric criteria or the lowest criterion for each parameter.

WASTELOAD ALLOCATION FOR LAKE MICHIGAN

WQBELs are derived by determining the assimilative capacity of the receiving water body using wasteload allocation techniques. Assimilative capacity refers to the total amount or loading of a constituent that a receiving water body may contain without exceeding a water quality standard applicable to the designated use. The assimilative capacity is comprised of loads from natural "background" sources, non-point source contributions, and point source contributions. A water body is described as "having assimilative capacity" if specific loads (point or non-point) may be introduced or added to the system without causing the receiving water concentrations to be greater than the water quality standards.

The assimilative capacity of a system can be determined mathematically and/or through long-term monitoring. Long-term monitoring of background concentrations of constituents present in the south end of Lake Michigan and subject to Indiana water quality standards

FIGURE 6-1. PROCEDURE FOR DETERMING THE NEED FOR A WQBEL



NOTES:
(a) WQBEL - Water Quality Based Effluent Limit
(b) TSD - Technical Support Document for Water Quality-Based Toxics Control, U.S. EPA March 1991
(c) IWQS - Indiana Water Quality Standard

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TABLE 6-3. OUTFALL 001 AND WLA BIOCHEMICAL OXYGEN DEMAND (BOD) DATA

PARAMETER	MAXIMUM DAILY MAXIMUM		MAXIMUM MONTHLY AVERAGE	
	CONCENTRATION (mg/L)	LOAD (lbs/day)	CONCENTRATION (mg/L)	LOAD (lbs/day)
Outfall 001 Historical Performance for TBOD (a,b)	29.0	3,580	5.8	721
Wasteload Allocation CBOD for Model Segment 48 (c)	44.34	8,322.0	22.17	4,161.0

NOTES:
(a) Source is the maximum data reported in Form 2c of the permit application.
(b) Concentrations and loads are independent of each other, i.e., do not necessarily occur on the same date.
(c) Source is the "Wasteload Allocation of Grand Calumet River – Indiana Ship Canal," September, 1992.

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TABLE 6-2. DETERMINATION OF THE NEED FOR A WQBEL (a, ab)

PARAMETER	UNITS	NUMBER OF SAMPLES	PERCENT NON DETECTS	MAXIMUM VALUE	COEFFICIENT OF VARIATION (b)	ACUTE REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	CHRONIC REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	ACUTE MAXIMUM EXPECTED EFFLUENT CONCENTRATION	CHRONIC MAXIMUM EXPECTED EFFLUENT CONCENTRATION	BACKGROUND CONCENTRATION	ACUTE RECEIVING WATER CONCENTRATION	CHRONIC RECEIVING WATER CONCENTRATION	IS AN ACUTE WQBEL NEEDED ?	IS A CHRONIC WQBEL NEEDED ?
OTHER SUBSTANCES														
Asbestos	fibers/liter												No (k)	No (k)
Chlorides	mg/L	26	0	320	0.288	1.6	1.2	512	384	11 (q)	20.11	15.78	No (l, aa)	Yes
Chlorine (Total Residual)	µg/L	1	100										No (i)	No (i)
Chlorine (g)	mg/L												No (p)	No (p)
Cyanide (Total)	µg/L	6	0	19	0.6	3.8	2.1	72.2	39.9	0.20 (q)	1.51	0.71	No (n)	No (o)
Nitrate-N - Nitrite-N	mg/L												No (k)	No (k)
Nitrite-N	mg/L												No (k)	No (k)
Phenols	mg/L	482	85										No (j)	No (j)
Sulfates	mg/L	6	0	381	0.6	4.2	2.3	1,600	876	25.0 (q)	(ab)	35.91	No (ab)	Yes
Total Phosphorous	mg/L	6	0	0.530	0.6	3.8	2.1	2.01	1.11	0.03 (r)	(ab)	0.04	No (ab)	Yes
Filterable Solids (h)	mg/L	9	0	1,239	0.6	3.2	1.8	3,965	2,230	170.0 (q)	(ab)	196.41	No (ab)	Yes
Fluorides	mg/L	1	0	0.3	0.6	13.2	6.2	3.96	1.86	0.1 (r)	(ab)	0.12	No (ab)	No (o)
Dissolved Iron	µg/L	4	0	120	0.6	4.7		564		40 (s)	(ab)		No (ab)	No (ac)
Ammonia as N (summer) (u)	mg/L	806	8	13	2.39	6.8	2.0	88.4	26	0.01 (q)	(ab)	0.34	No (ab)	Yes
TOXICITY														
Chronic Toxicity for Fathead Minnow	TUc (v)	7	(w)	16	0.6		2.0		32	0 (x)		0.4		No (y)
Chronic Toxicity for Ceriodaphnia dubia	TUc (v)	8	(w)	8	0.6		1.9		15.2	0 (x)		0.2		No (y)

NOTES:
(a) Assuming the following dispersion
Zone of Discharge Induced Mixing = 54 :1
Total Mixing Zone = 77 :1
(b) Coefficient of Variance, CV = Standard Deviation/Average. Where n<10 CV=0.6.
(c) Acute values from Table 3-1 and chronic values from Table 3-2 of the March 1991 TSD.
(d) Acid soluble, except as indicated
(e) Lake Michigan Hardness = 142 mg/L
(f) Dissolved.
(g) Intermittent total residual.
(h) Dissolved solids.
(i) No WQBEL needed since 100 percent of samples were non detect.
(j) No WQBEL needed since at least 75 percent of samples were non detect.
(k) No WQBEL needed since criterion only applies to a point of water intake.
(l) No WQBEL needed since the acute maximum expected discharge concentration is less than the criterion/limit.
(m) No WQBEL needed since the chronic maximum expected discharge concentration is less than the criterion/limit.
(n) No WQBEL needed since the acute maximum receiving water concentration is less than the criterion/limit.
(o) No WQBEL needed since the chronic maximum receiving water concentration is less than the criterion/limit.
(p) No WQBEL needed since this parameter is believed to be absent from the Outfall 001 discharge.
(q) Source is the "Wasteload Allocation of Grand Calumet River – Indiana Harbor Ship Canal", IDEM, September 1992.
(r) USEPA STORET database 1965-92.
(s) USEPA STORET database 1969-92.
(t) Chromium (III) is the same as total chromium.
(u) Comparison made to summer standard since summer is the limiting season.
(v) Chronic toxicity unit, TUc = (100 / NOEL)
(w) Not applicable.
(x) Reference: TSD for Water Quality – based Toxicity Control (March 1991 TSD), Section 7.2.3.
(y) No WQBEL needed since the TUc < 1.0 (Reference: March 1991 TSD, Section 3.3.3.)
(aa) No acute WQBEL needed for Lake Michigan Standard since it is applied outside a mixing zone.
(ab) Shading indicates the point at which a parameter drops out of the PEQ process.
(ac) No WQBEL needed since there is no chronic criterion.

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TABLE 6-2. DETERMINATION OF THE NEED FOR A WQBEL (a, ab)

PARAMETER	UNITS	NUMBER OF SAMPLES	PERCENT NON DETECTS	MAXIMUM VALUE	COEFFICIENT OF VARIATION (b)	ACUTE REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	CHRONIC REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	ACUTE MAXIMUM EXPECTED EFFLUENT CONCENTRATION	CHRONIC MAXIMUM EXPECTED EFFLUENT CONCENTRATION	BACKGROUND CONCENTRATION	ACUTE RECEIVING WATER CONCENTRATION	CHRONIC RECEIVING WATER CONCENTRATION	IS AN ACUTE WQBEL NEEDED ?	IS A CHRONIC WQBEL NEEDED ?
Dieldrin	µg/L	1	100										No (i)	No (i)
2,4-dinitrotoluene	µg/L	1	100										No (i)	No (i)
Dioxin (2,3,7,8-TCDD)	µg/L												No (p)	No (p)
1,2-diphenylhydrazine	µg/L	1	100										No (i)	No (i)
Endosulfan	µg/L	1	100										No (i)	No (i)
Endrin	µg/L												No (k)	No (k)
Ethylbenzene	µg/L	1	100										No (i)	No (i)
Fluoranthene	µg/L	1	100										No (i)	No (i)
Halomethanes	µg/L												No (p)	No (p)
Heptachlor	µg/L	1	100										No (i)	No (i)
Hexachlorobutadiene	µg/L	1	100										No (i)	No (i)
Hexachlorocyclohexane (HCH)														
alpha HCH	µg/L												No (p)	No (p)
beta HCH	µg/L												No (p)	No (p)
gamma HCH	µg/L												No (p)	No (p)
(Lindane)	µg/L												No (p)	No (p)
Technical HCH	µg/L												No (p)	No (p)
Hexachlorocyclopentadiene	µg/L	1	100										No (i)	No (i)
Isophorone	µg/L	1	100										No (i)	No (i)
Nitrobenzene	µg/L												No (k)	No (k)
Nitrophenols														
2,4-dinitro-o-cresol	µg/L												No (p)	No (p)
Dinitrophenol	µg/L												No (p)	No (p)
Nitrosamines														
N-nitrosodiethylamine	µg/L												No (p)	No (p)
N-nitrosodimethylamine	µg/L	1	100										No (i)	No (i)
N-nitrosodibutylamine	µg/L	1	100										No (p)	No (p)
N-nitrosodiphenylamine	µg/L	1	100										No (i)	No (i)
N-nitrosopyrrolidine	µg/L												No (p)	No (p)
Parathion	µg/L												No (p)	No (p)
Pentachlorophenol	µg/L	1	100										No (i)	No (i)
Phenol	µg/L												No (k)	No (k)
Phthalate Esters														
Dimethyl phthalate	µg/L	1	100										No (i)	No (i)
Diethyl phthalate	µg/L	1	100										No (i)	No (i)
Dibutyl phthalate	µg/L												No (p)	No (p)
Di-2-ethylhexyl phthalate	µg/L												No (p)	No (p)
Polychlorinated Biphenyls (PCBs)	µg/L												No (p)	No (p)
Carcinogenic Polynuclear Aromatic	µg/L												No (p)	No (p)
Hydrocarbons (PAHs)	µg/L	1	100										No (i)	No (i)
Tetrachloroethylene	µg/L	1	100										No (i)	No (i)
Toluene	µg/L	1	100										No (i)	No (i)
Toxaphene	µg/L	1	100										No (i)	No (i)
Trichloroethylene	µg/L	1	100										No (i)	No (i)
Vinyl Chloride	µg/L	1	100										No (i)	No (i)

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TABLE 6-2. DETERMINATION OF THE NEED FOR A WQBEL (a, ab)

PARAMETER	UNITS	NUMBER OF SAMPLES	PERCENT NON DETECTS	MAXIMUM VALUE	COEFFICIENT OF VARIATION (b)	ACUTE REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	CHRONIC REASONABLE POTENTIAL MULTIPLYING FACTOR (c)	ACUTE MAXIMUM EXPECTED EFFLUENT CONCENTRATION	CHRONIC MAXIMUM EXPECTED EFFLUENT CONCENTRATION	BACKGROUND CONCENTRATION	ACUTE RECEIVING WATER CONCENTRATION	CHRONIC RECEIVING WATER CONCENTRATION	IS AN ACUTE WQBEL NEEDED ?	IS A CHRONIC WQBEL NEEDED ?
METALS (d)														
Antimony	μg/L	4	100										No (i)	No (i)
Arsenic (III)	μg/L	7	100										No (i)	No (i)
Barium	μg/L												No (k)	No (k)
Beryllium	μg/L	4	75										No (j)	No (j)
Cadmium (e)	μg/L	7	100										No (i)	No (i)
Chromium (III) (e) (f)	μg/L	165	88										No (j)	No (j)
Chromium(VI) (f)	μg/L	161	0	7	0.600	2.3	1.4	16.1	9.8	10 (r)	10.11		No (n)	No (m)
Copper (e)	μg/L	8	63	29	0.6	5.6	3.0	162.4	87	1.085 (q)	4.02	2.19	No (n)	No (o)
Lead (e)	μg/L	9	11	13	0.6	3.8	2.1	49.4	27.3	0.34 (q)		0.69	No (i)	No (o)
Mercury	μg/L	5	100										No (i)	No (i)
Nickel (e)	μg/L	7	86										No (j)	No (j)
Selenium	μg/L	10	0	45	0.4	3.0	1.7	135	76.5	0.5 (r)	2.95	1.47	No (n)	No (o)
Silver (e)	μg/L	4	100										No (i)	No (i)
Thallium	μg/L	4	100										No (i)	No (i)
Zinc (e)	μg/L	9	0	269	0.6	3.6	2.0	968	538	8.81 (q)	26.26	15.59	No (n)	No (o)
ORGANICS														
Acrolein	μg/L	1	100										No (i)	No (i)
Acrylonitrile	μg/L	1	100										No (i)	No (i)
Aldrin	μg/L	1	100										No (i)	No (i)
Benzene	μg/L	1	100										No (i)	No (i)
Benzidine	μg/L	1	100										No (i)	No (i)
Carbon Tetrachloride	μg/L	1	100										No (i)	No (i)
Chlordane	μg/L	1	100										No (i)	No (i)
Chlorinated Benzenes														
Monochlorobenzene	μg/L												No (k)	No (k)
1,2,4,5-Tetrachlorobenzene	μg/L												No (p)	No (p)
Pentachlorobenzene	μg/L												No (p)	No (p)
Hexachlorobenzene	μg/L	1	100										No (i)	No (i)
Chlorinated Ethanes														
1,2-dichloroethane	μg/L	1	100										No (i)	No (i)
1,1,1-trichloroethane	μg/L	1	100										No (i)	No (i)
1,1,2-trichloroethane	μg/L	1	100										No (i)	No (i)
1,1,2,2-tetrachloroethane	μg/L												No (p)	No (p)
Hexachloroethane	μg/L	1	100										No (i)	No (i)
Chlorinated Phenols														
2,4,5-trichlorophenols	μg/L												No (k)	No (k)
2,4,6-trichlorophenols	μg/L	1	100										No (i)	No (i)
Chloroalkyl Ethers														
bis(2-chloroisopropyl) ether	μg/L	1	100										No (i)	No (i)
bis(chloromethyl) ether	μg/L	1	100										No (i)	No (i)
bis(2-chloroethyl) ether	μg/L	1	100										No (i)	No (i)
Chloroform	μg/L	1	100										No (i)	No (i)
Chloropyrifos	μg/L												No (p)	No (p)
DDT	μg/L												No (p)	No (p)
Dichlorobenzenes	μg/L												No (p)	No (p)
Dichlorobenzidine	μg/L												No (p)	No (p)
1,1-dichloroethylene	μg/L	1	100										No (i)	No (i)
2,4-dichlorophenol	μg/L												No (k)	No (k)
Dichloropropenes	μg/L	1	100										No (p)	No (p)

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TABLE 6-1. SUMMARY OF INDIANA WATER QUALITY STANDARDS (327 IAC 2-1-6)

PARAMETER	UNITS	AAC (a,b) (Maximum)	CCC (4-Day Average) (a,b)			LAKE MICHIGAN STANDARDS (c)	
			Outside of Mixing Zone		Point of Water Intake	Monthly Average	Daily Maximum
			Aquatic Life (CAC)	Human Health	Human Health		
Hexachlorocyclopentadiene	µg/L				206		
Isophorone	µg/L			520,000	5,200		
Nitrobenzene	µg/L				19,800		
Nitrophenols							
2,4-dinitro-o-cresol	µg/L			765	13.4		
Dinitrophenol	µg/L			14,300	70		
Nitrosamines							
N-nitrosodiethylamine	µg/L			12.4	0.008		
N-nitrosodimethylamine	µg/L			160	0.014		
N-nitrosodibutylamine	µg/L			5.9	0.064		
N-nitrosodiphenylamine	µg/L			161	49		
N-nitrosopyrrolidine	µg/L			919	0.16		
Parathion	µg/L	0.065	0.013				
Pentachlorophenol	µg/L				1,000		
Phenol	µg/L				3,500		
Phthalate Esters							
Dimethyl phthalate	µg/L			2,900,000	313,000		
Diethyl phthalate	µg/L			1,800,000	350,000		
Dibutyl phthalate	µg/L			154,000	34,000		
Di-2-ethylhexyl phthalate	µg/L			50,000	15,000		
Polychlorinated Biphenyls (PCBs)	µg/L		0.014	0.00079	0.00079		
Carcinogenic Polynuclear Aromatic	µg/L						
Hydrocarbons (PAHs)	µg/L			0.31	0.028		
Tertrachloroethylene	µg/L			88.5	8		
Toluene	µg/L			424,000	14,300		
Toxaphene	µg/L	0.73	0.0002	0.0073	0.0071		
Trichloroethylene	µg/L			807	27		
Vinyl Chloride	µg/L			5246	20		
OTHER SUBSTANCES							
Asbestos	fibers/liter				300,000		
Chlorides	mg/L	860	230			15	20
Chlorine (Total Residual)	µg/L	19	11				
Chlorine (g)	mg/L	0.2					
Cyanide (Total)	µg/L	22	5.2		200		
Nitrate-N - Nitrite-N	mg/L				10		
Nitrite-N	mg/L				1.0		
Dissolved Oxygen	mg/L					7.0	
pH	s.u.						7.5-8.5
Phenols	mg/L					0.001	0.003
Sulfates	mg/L		250 (h)			26	50
Total Phosphorous	mg/L					0.03	0.04
Filtrable Solids (i)	mg/L		750 (h)			172	200
Fluorides	mg/L		2.0 (h)				1.0
Dissolved Iron	µg/L						300
Ammonia as N (k)	mg/L						
- Summer (l)	mg/L					0.23	0.46
- Winter (m)	mg/L					1.24	2.48

NOTES:
(a) 327 IAC 2-1-6(a) Table 1, unless otherwise noted.
(b) AAC - Acute Aquatic Criterion
CCC - Continuous Criterion Concentration
CAC - Chronic Aquatic Criterion
(c) 327 IAC 2-1-6(j).
(d) Acid soluble, except as indicated.
(e) Lake Michigan Hardness = 142 mg/L.
(f) Dissolved.
(g) Intermittent total residual.
(h) Limit included in notes following Table 1.
(i) Filtrable or dissolved solids.
(j) Chromium (III) is the same as total chromium.
(k) Monthly average unionized ammonia standard is converted to total ammonia as N at given pH and temperature conditions. Temperature and pH values are the 75 percentile values for Lake Michigan as used in the IDEM Wasteload Allocation, September 1992. Daily maximum equals twice the monthly average concentration as per OWM-1.
(l) At pH 8.2 and 22.9°C for July through September. See note (k).
(m) At pH 8.0 and 6 °C for October through June. See note (k).

TABLE 6-1. SUMMARY OF INDIANA WATER QUALITY STANDARDS (327 IAC 2-1-6)

PARAMETER	UNITS	AAC (a,b) (Maximum)	CCC (4-Day Average) (a,b)			LAKE MICHIGAN STANDARDS (c)	
			Outside of Mixing Zone		Point of Water Intake	Monthly Average	Daily Maximum
			Aquatic Life (CAC)	Human Health	Human Health		
METALS (d)							
Antimony	µg/L			45,000	146		
Arsenic (III)	µg/L	360	190	0.175	0.022		
Barium	µg/L				1,000		
Beryllium	µg/L			1.17	0.068		
Cadmium (e)	µg/L	5.83	1.49		10		
Chromium (III) (e) (j)	µg/L	2,314.2	275.8	3,433,000	170,000		
Chromium(VI)	µg/L	16 (f)	11		50		
Copper (e)	µg/L	24.66	15.95				
Lead (e)	µg/L	127.58	4.97		50		
Mercury	µg/L	2.4	0.012	0.15	0.14		
Nickel (e)	µg/L	1,908.0	212.1	100	13.4		
Selenium	µg/L	130	35		10		
Silver (e)	µg/L	3.71			50		
Thallium	µg/L			48	13		
Zinc (e)	µg/L	157.51	142.7				
ORGANICS							
Acrolein	µg/L			780	320		
Acrylonitrile	µg/L			6.5	0.58		
Aldrin	µg/L	1.5		0.00079	0.00074		
Benzene	µg/L			400	6.6		
Benzidine	µg/L			0.0053	0.0012		
Carbon Tetrachloride	µg/L			69.4	4.0		
Chlordane	µg/L	1.2	0.0043	0.0048	0.0046		
Chlorinated Benzenes							
Monochlorobenzene	µg/L				488		
1,2,4,5-Tetrachlorobenzene	µg/L			48	38		
Pentachlorobenzene	µg/L			85	74		
Hexachlorbenzene	µg/L			0.0074	0.0072		
Chlorinated Ethanes							
1,2-dichloroethane	µg/L			2430	9.4		
1,1,1-trichloroethane	µg/L			1,030,000	18,400		
1,1,2-trichloroethane	µg/L			418	6		
1,1,2,2-tetrachloroethane	µg/L			107	1.7		
Hexachloroethane	µg/L			87.4	19		
Chlorinated Phenols							
2,4,5-trichlorophenol	µg/L				2600		
2,4,6-trichlorophenol	µg/L			36	12		
Chloroalkyl Ethers							
bis(2-chloroisopropyl) ether	µg/L			4360	34.7		
bis(chloromethyl) ether	µg/L			0.018	0.000038		
bis(2-chloroethyl) ether	µg/L			13.6	0.3		
Chloroform	µg/L			157	1.9		
Chloropyrifos	µg/L	0.083	0.041				
DDT	µg/L	0.55	0.001	0.00024	0.00024		
Dichlorobenzenes	µg/L			2,600	400		
Dichlorobenzidine	µg/L			0.2	0.1		
1,1-dichloroethylene	µg/L			18.5	0.33		
2,4-dichlorophenol	µg/L				3,090		
Dichloropropenes	µg/L			14,100	87		
Dieldrin	µg/L	1.3	0.0019	0.00076	0.00071		
2,4-dinitrotoluene	µg/L			91	1.1		
Dioxin (2,3,7,8-TCDD)	µg/L			0.0000001	0.0000001		
1,2-diphenylhydrazine	µg/L			5.6	0.422		
Endosulfan	µg/L	0.11	0.056	159	74		
Endrin	µg/L	0.09	0.0023		1.0		
Ethylbenzene	µg/L			3,280	1,400		
Fluoranthene	µg/L			54	42		
Halomethanes	µg/L			157	1.9		
Heptachlor	µg/L	0.26	0.0038	0.0028	0.0028		
Hexachlorobutadiene	µg/L			500	4.47		
Hexachlorocyclohexane (HCH)							
alpha HCH	µg/L			0.31	0.09		
beta HCH	µg/L			0.55	0.16		
gamma HCH	µg/L						
(Lindane)	µg/L	1.0	0.08	0.63	0.19		
Technical HCH	µg/L			0.41	0.12		

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